REMARKS

Claims 1-33 are pending in the present application. Claims 1-6, 8, 9 and 12-33 are rejected. Claims 7, 10 and 11 are objected to. Claims 4 and 27-33 are herein canceled. Claims 1, 2, 3, 5, 7, 17 and 24 are herein amended. Attached hereto is a marked-up version of the changes made by the current amendment, captioned "Version with Markings to Show Changes Made."

Claim Rejections under 35 U.S.C. §112, second paragraph

Claim 2 is rejected under 35 U.S.C. §112, second paragraph, as being indefinite. The Examiner asserts that there is insufficient structure cited in the claim to obtain a band gap reduction as claimed, and that the claim merely recites a desired result.

Applicants herein amend the claim to more accurately recite the relative levels of band gap energy.

Claims 3-5, 24 and 31 are rejected under 35 U.S.C. §112, second paragraph, because the Examiner asserts that it is unclear as to how the depletion layer is formed on the flat portion when the flat portion is formed on the active layer.

Applicants respectfully disagree with this rejection, because Figure 1 clearly shows the structure of the claim. Applicants note that the Examiner may be referring to the particular words used in the claim, and therefore amend the words to mirror that of claim 1, i.e., "provided" instead of "formed".

[redacted]

Applicants further note that the Examiner may be indicating that it is not clear how the depletion layer is formed on the flat portion when the ridge portion is formed on the flat portion. Therefore, Applicants herein amend claim 3 to recite that the ridge portion is formed on a portion of said flat portion, to indicate it is not formed over the entire flat portion.

Claims 17-33 are rejected under 35 U.S.C. §112, second paragraph, because Applicants claim a "low carrier concentration layer", and it is not clear what is meant by low carrier concentration.

Applicants herein amend the claim to more clearly recite the invention.

Claim 18 is rejected under 35 U.S.C. §112, second paragraph, because there is insufficient structure cited in the claim to obtain a narrower band gap as claimed, and that the claim merely recites a desired result.

Applicants respectfully disagree with this rejection. We understand that band gap is a measurable attribute that essentially indicates the point in the insulator ⇌ conductor spectrum on which the material lies. One skilled in the art would easily recognize this reference.

Claim 19 recites the limitation "said band-to-band levels" in line 3, and there is insufficient antecedent basis for this limitation in the claim.

Applicants respectfully disagree with this rejection, and note that the penultimate clause of claim 17, from which claim 19 depends, reads "...said depletion enhancement layer has an energy level in band gap supplying second conduction type carriers..." Applicants submit that this provides sufficient antecedent basis.

Claim Rejections under 35 U.S.C. §102(e)

Claims 1-6, 8, 9, 12, 14, 17-24, 27-33 are rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,181,723 to Okubo et al.

The Examiner asserts that in Figure 22, Okubo et al. illustrates a semiconductor laser having an active layer (954), a cladding layer (955) formed on the active layer, an etch stop layer (956) having a thickness of .003μm, which is the same as Applicants' depletion layer formed on the cladding layer, a current blocking layer (960), which is the same as Applicants' low carrier concentration layer formed on the etch stop layer and a current block layer (965) having a higher carrier concentration than current layer (960), as described in column 22 example 10.

Claims 4 and 27-33 are herein canceled. With respect to the remaining rejections, Applicants respectfully disagree with this rejection, because not all of the claim limitations are taught by the cited reference.

Applicants note that in the semiconductor laser device show in Fig. 22 of Okubo et al., an etch stop layer 956 has a thickness of 0.003 μm (3nm), which fails to attain the same function as the depletion enhancement layer of the present invention. As has been clarified in the above-described amendment, the depletion enhancement layer of the present invention has a thickness of at least 10 nm, which results in significant improvements in cut-off frequency and high-frequency characteristics. This is indicated in Figs. 6, 8 and 9 and their relevant descriptions in the specification.

Further, in the semiconductor laser device shown in Fig. 22 of Okubo et al., a current blocking layer 960 has a high carrier concentration of 1 x $10^{18}cm^{-3}$ (the eighteenth power of 10), which fails to attain the same function as the low carrier concentration layer of the present invention. It is required that the layer is undoped, or alternatively, doped by a very small amount (e.g., at most 5 x $10^{17}cm^{-3}$) in order to attain the same function as the low carrier concentration layer. Applicants submit that there is no apparent description in the cited reference applicable to claim limitation regarding this matter.

As to claim 17 of the present application, the feature of claim 17 is that the depletion enhancement layer has a energy level in band gap supplying second conduction type carriers to compensate first conduction type carriers supplied from the first cladding layer due to a modulation doping effect. This feature is not disclosed at all in Okubo et al. Therefore, Applicants submit that not every limitation is disclose in the cited reference.

Claim Rejections under 35 U.S.C. §103(a)

Claims 13-15 and 16 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,305,341 to Nishikawa et al.

The Examiner asserts that it is well known in the laser art to use any of the claimed semiconductor materials to established an ordered structure for a semiconductor laser, as illustrated in figures 5 and 10 of Nishikawa et al.

Applicants respectfully disagree with the Examiner's rejection, primarily because the Examiner has failed to show a reference or combination of references that teaches or suggest all the elements of the claimed invention. Another consideration is that, even if both of the cited references combined contained all the elements of the invention, the Examiner has not shown a motivation to combine and modify the cited reference to reach the claimed invention. While Nishikawa et al. appears to show the use of some of the claimed semiconductor materials in a laser, it does not appear to teach or suggest all of the elements of claim 1, including a low carrier concentration layer provided on the side of the current blocking layer between the first cladding layer and the current blocking layer and having a lower carrier concentration than the current blocking layer; and a depletion enhancement layer provided on the side of the first cladding layer between the first cladding layer and the current blocking layer for inhibiting storage of carriers in the low carrier concentration layer.

For at least the above reasons, Applicants submit that the claimed invention, as herein amended, sufficiently distinguishes over the cited references. Withdrawal of the rejections and passage of the claims to issue are earnestly requested.

If the Examiner believes that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

[redacted]

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees that may be due with respect to this paper to Deposit Account No. 01-2340.

Respectfully submitted,

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Enclosures: Version with markings to show changes made

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please amend claims 1, 2, 3, 5, 7, 17 and 24 as follows:

1. (Amended) A semiconductor laser device comprising:

an active layer;

a first cladding layer of a first conduction type provided on said active layer;

a current blocking layer of a second conduction type provided on said first cladding layer except a current injection region;

a low carrier concentration layer provided on the side of said current blocking layer between said first cladding layer and said current blocking layer and having a lower carrier concentration than said current blocking layer; and

a depletion enhancement layer provided on the side of said first cladding layer between said first cladding layer and said current blocking layer for inhibiting storage of carriers in said low carrier concentration layer,

the thickness of the depletion enhancement layer is at least 10 nm.

2. (Amended) The semiconductor laser device according to claim 1, wherein

the band ~~gaps~~ gap of said first cladding layer ~~,~~ is larger than that of said depletion enhancement layer, and the band gap of said depletion enhancement layer is larger than that of said low carrier concentration layer ~~are reduced in this order~~.

3. (Amended) The semiconductor laser device according to claim 1, wherein

said first cladding layer has a flat portion formed on said active layer and a ridge portion formed on a portion of said flat portion in said current injection region,

said depletion enhancement layer is ~~formed~~ provided on said flat portion located on both sides of said ridge portion and on the side surfaces of said ridge portion, and

said low carrier concentration layer and said current blocking layer are successively formed on said depletion enhancement layer.

5. (Amended) The semiconductor laser device according to claim ~~4~~ 3, wherein

the thickness of said depletion enhancement layer is at least 15 nm.

7. (Amended) ~~The~~ A semiconductor laser device ~~according to claim 1, wherein~~ comprising:

an active layer;

a first cladding layer of a first conduction type provided on said active layer;

a current blocking layer of a second conduction type provided on said first cladding layer except a current injection region;

a low carrier concentration layer provided on the side of said current blocking layer between said first cladding layer and said current blocking layer and having a lower carrier concentration than said current blocking layer; and

a depletion enhancement layer provided on the side of said first cladding layer between said first cladding layer and said current blocking layer for inhibiting storage of carriers in said low carrier concentration layer, wherein

said depletion enhancement layer, said low carrier concentration layer and said current blocking layer are successively formed on said first cladding layer except said current injection region,

said semiconductor laser device further comprising a second cladding layer of a first conduction type provided to fill up a space enclosed with the side surfaces of said depletion enhancement layer, said low carrier concentration layer and said current blocking layer and the upper surface of said first cladding layer in said current injection region.

17. (Amended) A semiconductor laser device comprising:

an active layer;

a first cladding layer of a first conduction type provided on said active layer;

a first current blocking layer ~~having a low carrier concentration~~ provided on said first cladding layer except a current injection region, said first current blocking layer having a carrier concentration;

a second current blocking layer of a second conduction type provided on said first current blocking layer, said second current blocking layer having a carrier concentration; and

a depletion enhancement layer formed between said first cladding layer and said first current blocking layer for inhibiting storage of carriers in said first current blocking layer, wherein

said depletion enhancement layer has a thickness of at least 10 nm, and has an energy level in band gap supplying second conduction type carriers to compensate for first conduction type carriers supplied from said first cladding layer due to a modulation doping effect; and further wherein

the first current blocking layer has a lower carrier concentration than the second current blocking layer.

24. (Amended) The semiconductor laser device according to claim 17, wherein

said first cladding layer has a flat portion formed on said active layer and a ridge portion formed on a portion of said flat portion in said current injection region,

said depletion enhancement layer is ~~formed~~ provided on said flat portion located on both sides of said ridge portion and on the side surfaces of said ridge portion, and

said first current blocking layer is formed on said depletion enhancement layer.

[redacted]